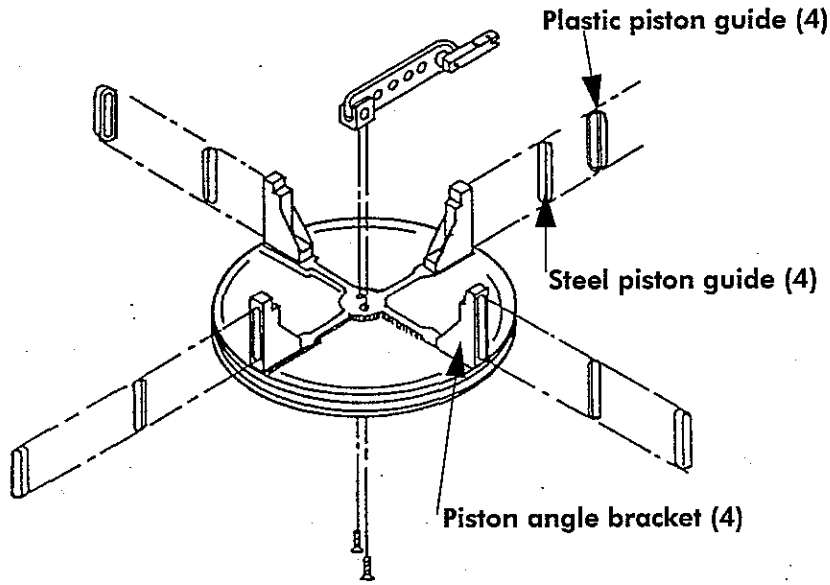
5. Install two new 8-32 x 3/8" hex set screws into each of the piston angle brackets. The ends of the screws should be flush with the inside of the bracket.

Figure 4.5



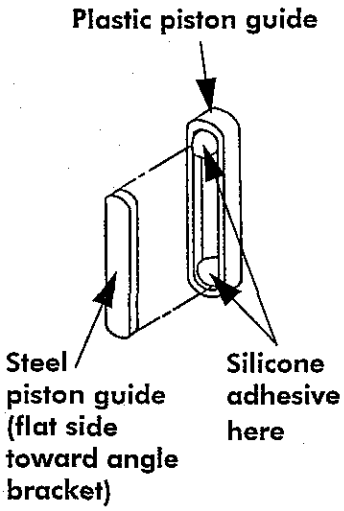


Figure 4.6

6. Insert a steel guide into each piston angle bracket, flat side first. *Apply two beads of silicone adhesive into plastic piston guides.* (Figure 4.6)

Caution Small amounts of silicone should be used so it does not seep out into the assembly later.

7. Insert plastic guides into angle brackets, silicone side inward. Check that no silicone is exposed, wipe clean if necessary.

8. Inspect the Quadring and install into piston groove, verify it is not twisted.

9. Inspect the Kapseal, assuring that it has no creases or nicks. Install the Kapseal over the Quadring as shown in Figure 4.7.

Caution Be very careful not to stretch the Kapseal.

10. With a fingernail or plastic screwdriver, work the Kapseal over the entire Quadring. Ensure the flanges at the edges of the Kapseal are seated between the Quadring and flange on both sides of the piston as shown. (Figure 4.8)

Caution It is common for the Kapseal to rest on the piston or Quadring as shown. (Figure 4.9) Keep working the Kapseal around the perimeter of the piston until it is properly seated.

11. Verify proper installation by running a finger around the Kapseal feeling for bumps or gaps. Look down the edge of the piston and ensure the Kapseal is flat and not at an angle, as shown. (Figure 4.10)

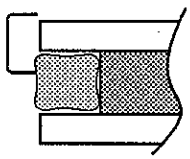


Figure 4.7

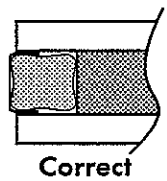


Figure 4.8

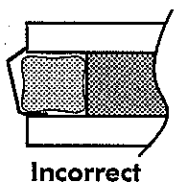


Figure 4.9

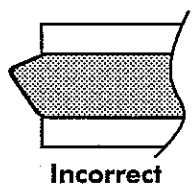


Figure 4.10

Piston Installation

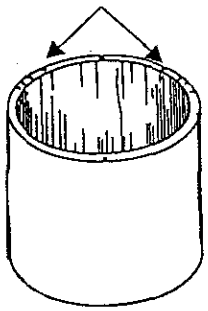


Figure 4.11

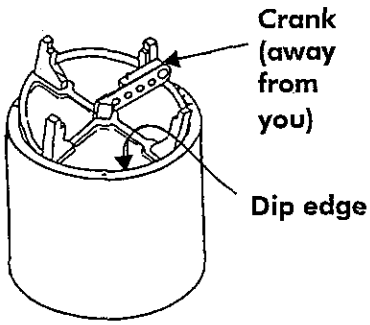


Figure 4.12

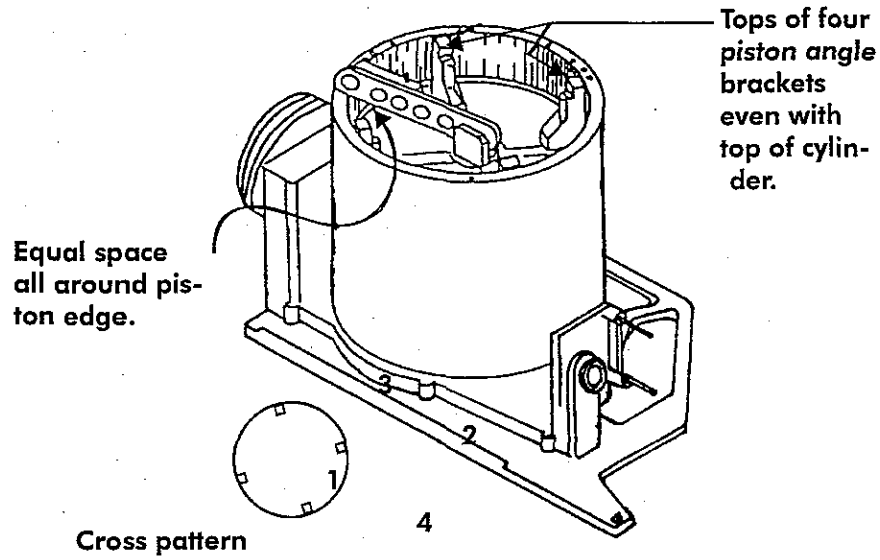
1. Inspect the Kapseal on the piston to ensure that it has not been damaged. If it has, a new Kapseal must be installed. Check for three nylon washers and three ring retainers on the crank arm.

2. Place the cylinder with the motor mounting holes away from you. (Figure 4.11)

3. Orient the piston so that the crankarm is also directly away from you. Dip the front edge of the piston just down into the cylinder. (Figure 4.12) Press the piston against the cylinder wall so that the Kapseal at the rear of the piston will not catch on the top of the cylinder as you gently ease the remainder of the piston into the cylinder.

4. Position the piston in the cylinder so that the tops of all four piston angle brackets are even with the top of the cylinder. Turn the bottom set screw in one angle bracket until the plastic piston guide just touches the cylinder wall. Turn the top set screw so that the top of the guide also just touches. Then turn the bottom set screw again to take up any slack. Using a cross pattern, do this with all four piston angle brackets, making sure that the tops of all four brackets are even with the top of the cylinder and that the piston remains centered within the cylinder. (Figure 4.13)

Figure 4.13



Set Piston Tension

1. Work the piston back and forth in the cylinder a few times. Push the piston down into the cylinder about 3/4 of the way.

2. Place the right end plate assembly into the Right End Tester. Add the adapter plug to the manifold air tube. Clamp in place with the two clamps. Switch the tester on.

3. Press and hold the SET PISTON button. Look at the gauge on the left and see if the needle falls in the good range of 12–18 cmH_2O. Hold the button until the tops of the piston angle brackets are again even with the top of the cylinder.

Note: If a new cylinder is installed in a unit during a PM, the "Good" range is 20–25 cmH_2O.

4. If the tops of the piston angle brackets are equally distant from the top of the cylinder (within 1/16"), and the gauge needle was in the proper range while the piston was rising, then the brackets are adjusted correctly. Go to step 7.

5. If not correct. Adjust the set screws as follows:

Note: If the top set screw is a little tighter than the bottom screw that angle bracket will be forced a little higher. The reverse is true to cause an angle bracket to ride a little lower.

a. For brackets that are too high, loosen the top set screw slightly. Verify bottom set screw is still snug but not overly tight.

b. For brackets that are too low, tighten the top set screw slightly. Verify bottom set screw is still snug but not overly tight.

c. After adjustments are made, return to the beginning of this test to re-test the piston tension.

d. If the tension of the piston against the cylinder wall (as measured by the gauge) was outside the proper range, adjust all set screws an equal amount in all of the brackets. If above proper range adjust screws counter-clockwise to lower pressure. If below proper range adjust screws clockwise to raise pressure.

e. After adjustments are made, return to the beginning of this test to re-test the piston tension.

6. Repeat steps as necessary to obtain proper leveling and tension.

7. Check that the piston is centered in the cylinder.

System Leak Test

1. Press and hold the LEAK TEST button. The needle of the gauge on the right side must stay in the GOOD range when the leak test button is depressed. Pressure may drop very slowly when LEAK TEST button is released.
2. Press and hold the VENT button to release the pressure from inside the manifold.
3. Remove the assembly from the Right End Tester.
4. Remove the air tube adapter plug.
5. Apply a drop of Loctite 242 on each set screw and tilt the subassembly such that the Loctite flows around the threads, wipe off excess. Push the piston about 1/2 way down into the cylinder.
6. Inspect the Manifold Assembly and verify that:
   a. The solenoid is securely mounted.
   b. All three pieces of 1/4" internal tubing are present, seated properly, and no kinks are present.
   c. Patient Pressure and Exhalation Valve tubes appear straight, secure, and clean.

Motor/Gearbox Installation

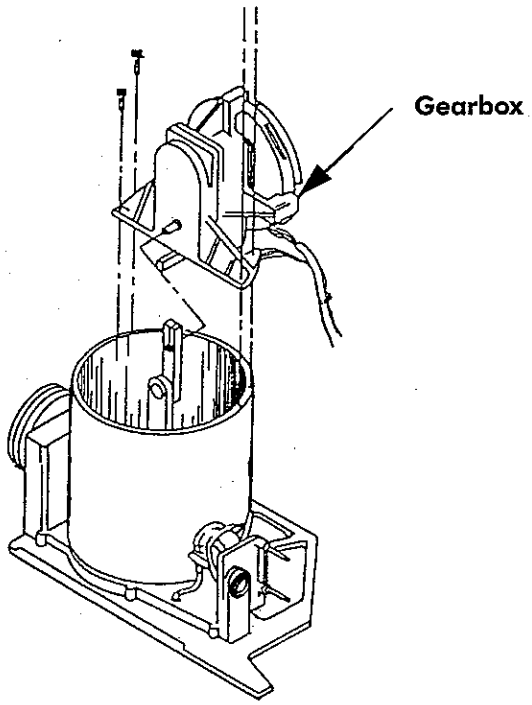
1. Inspect the Motor/Gearbox and verify that:

   - Wires are not damaged.
   - Wires are correctly positioned on magnetic sensor terminals as follows:

Wire Color	Position
red	(+)
yellow	(0)
black	(-)

   - Terminals are properly seated.
   - Two dowel pins are present and not bent in the base of the Motor/Gearbox.
   - There is no grease in the seam between the two halves of the Motor/Gearbox. Clean the gearbox of any residual grease.
   - Key is in the output shaft and fully seated in slot and its end is flush with the end of the output shaft.
   - There are no burrs on the key and crank.

Figure 4.14



2. Slip the gearbox's output shaft into the crank. (To get the key in the gear shaft to line up with the slot in the crank, you may both rotate the crank into position and/or rotate the rotor of the Motor/Gearbox to reposition the key in the output shaft.) (Figure 4.14)

3. Adjust the crankarm so it is flush with the end of the output shaft.

4. Position the gearbox on the right side of the cylinder so the left side of the crank arm is facing up.

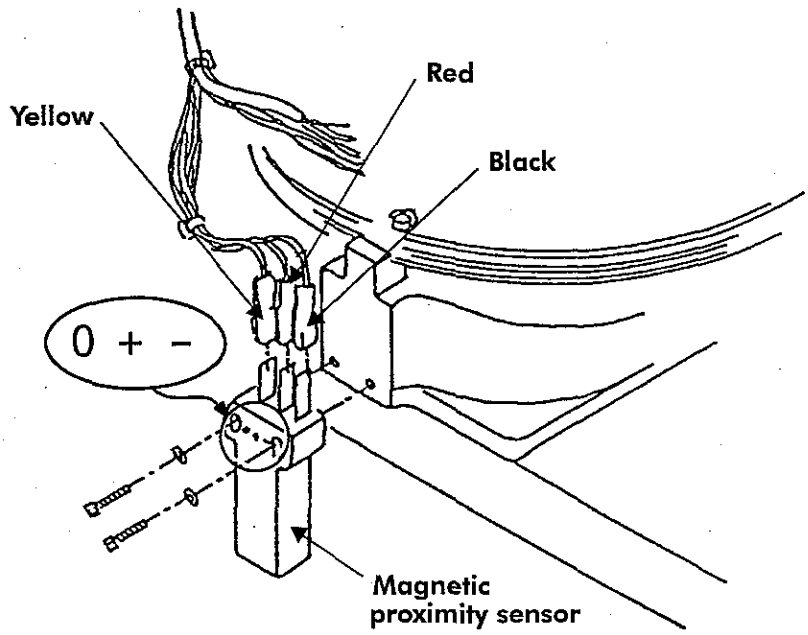
5. Apply a drop of Loctite 242 to the large cap-head screw, install into crank arm and tighten.

6. Position the gearbox on the left side of the cylinder so the right side of the crank arm is facing up.

7. Apply a drop of Loctite 242 to the small screw, install into crank arm and tighten.

8. Rotate the rotor until the magnetic sensor and the crank arm are aligned.

Figure 4.15



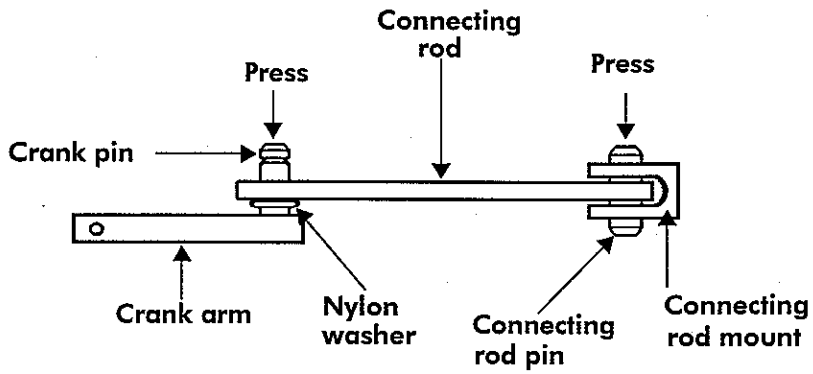
9. Loosen the two 4-40 x 3/4" cap-head hex screws and place the Magnetic Sensor Spacer between the magnetic sensor and the crankarm. Press the sensor firmly against the spacer; tighten in place. Remove the spacer. Check the spacing between the crank and the sensor using the Magnetic Sensor Gauge. Reset if not acceptable. (Figure 4.15)

10. Route motor wiring assembly toward the manifold air tube and ensure that they will not be pinched between the cylinder and the gearbox.

11. Push the piston into the cylinder or rotate the rotor so that the gearbox will align with the motor mounting holes in the cylinder. Insert the dowel pins on the base of the gearbox into the cylinder holes.

12. Secure the gearbox to the cylinder with four 6-32 x 1/2" cap-head hex screws using crisscross pattern. Re-check motor wire routing to ensure wires have not been pinched.

Figure 4.16



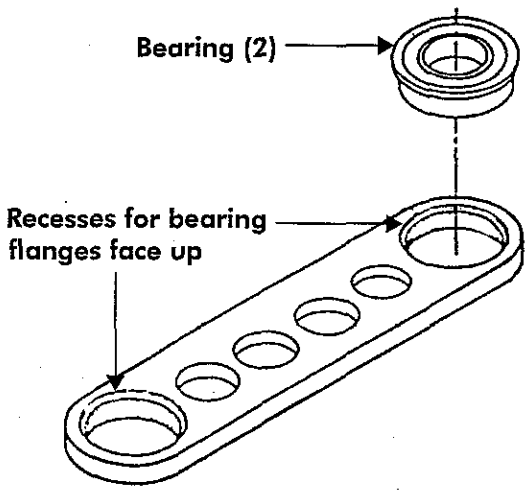
Bearing Replacement See Figure 4.16.

1. Remove the two 6-32 x 1/2" flat-head hex screws holding the connecting rod mount to the piston plate. Remove the three retaining rings from the crank assembly. Press the crank pin and the connecting rod pin out of the assembly.

Note: The crank pin must remain in the crank arm. The connecting rod pin should be pressed out with the locating mark up. (Figure 4.18)

2. Press the two bearings out of the connecting rod. Using Acetone, clean the adhesive residue from inside the bearing holes on the connecting rod. Lay the connecting rod on a paper towel so the counterbores for the bearing flanges are facing up.

Figure 4.17



3. Spray the inside of the holes for the bearings in the connecting rod with a brief burst of Loctite Primer N. Wipe the primer from the outer surface of the connecting rod. Allow the primer to dry for three minutes minimum.

4. Carefully clean the outside race on the two replacement bearings. Rotate the races of the bearings and feel for any roughness.

5. Apply a thin layer of Assure Electrical Retainer adhesive on the outside surface of the bearing.

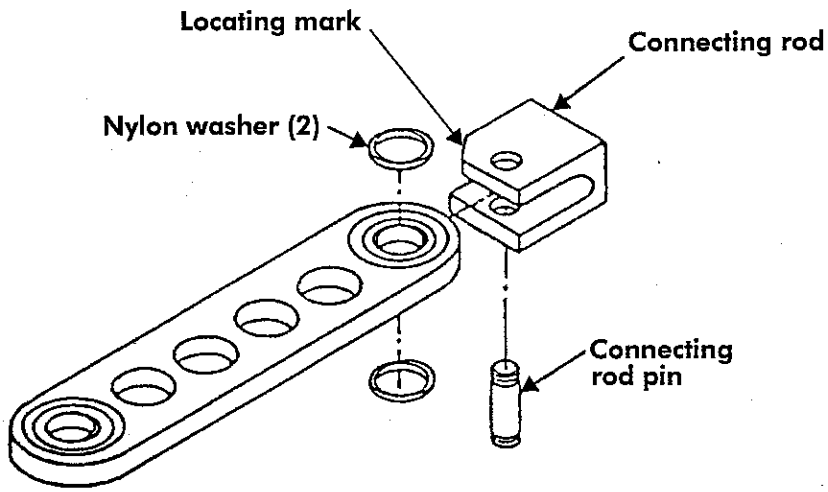
Note: Application of the adhesive should be followed by the installation of the component within one minute.

6. Press the bearing into the connecting rod, using a bearing press, bearing press tool, and bearing press plate. (Figure 4.17)

Caution Press only on the outer race of the bearings.

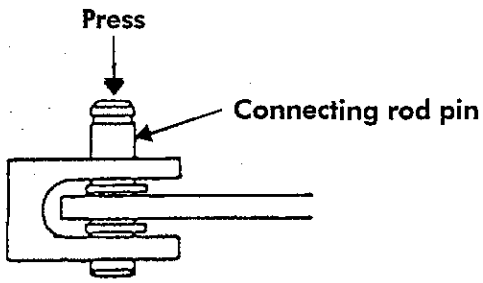
7. *Remove any excess adhesive.*

Figure 4.18



8. Hold the connecting rod mount with the locating mark side up. Start the connecting rod mount pin through the hole from below. Place a nylon washer, the connecting rod (bearing flanges up), and another nylon washer onto the pin. (Figure 4.18) Slip the pin up through these parts. Install the assembly in a mounting bracket press plate. Press the pin through the mount until the two grooves are equally spaced on either side of the mount. (Figure 4.19)

Figure 4.19



Note: *Turn over assembly and press as shown.*

Figure 4.21

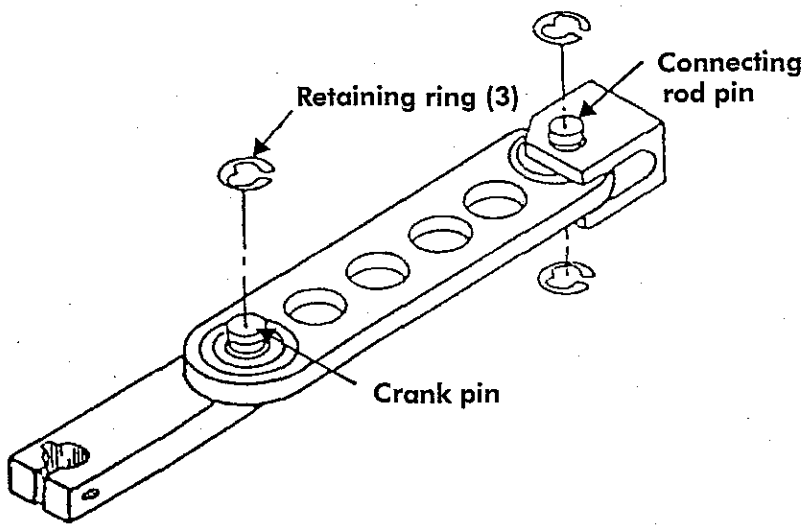
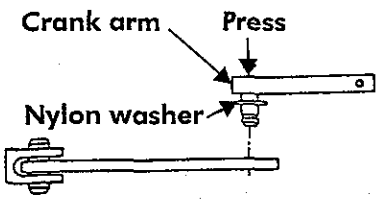


Figure 4.20



9. Apply a light coat of lubricant onto the crank pin. Slip a nylon washer onto the pin. Press the crank pin into the bearing until the groove just passes the bearing inner race. (Figure 4.20)

10. Push three retaining rings into the grooves on the pins. (Figure 4.21)

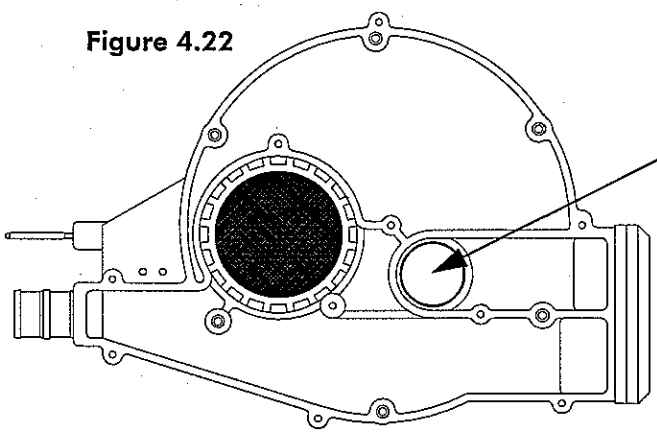
11. Inspect the assembly for workmanship. Ensure the three nylon washers are in place. Ensure the spacing on the pins is correct. Ensure the bearings are properly seated.

12. Apply silicone adhesive to the two mounting holes in the piston and attach the crank assembly onto the piston with two 6-32 x 1/2" flat-head hex screws.

Manifold, Leaf And/or Cylinder Replacement

1. Manifold and Cylinder Removal
   - a. Remove the gearbox and piston assemblies.
   - b. Remove all 16 screws from the right end plate.
   - c. Separate the manifold, cylinder and right end plate.
   - d. Remove all gasket material from manifold, cylinder and right end plate.
2. Remove retainer ring, filter screen and O-ring, if necessary.
3. If expiration leaf is replaced, reinstall O-ring, filter screen and retaining ring.

Figure 4.22



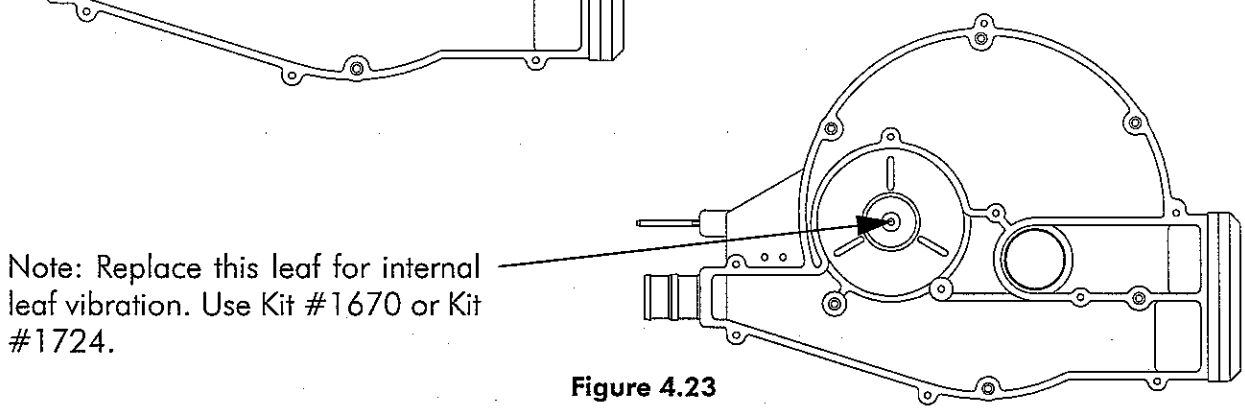
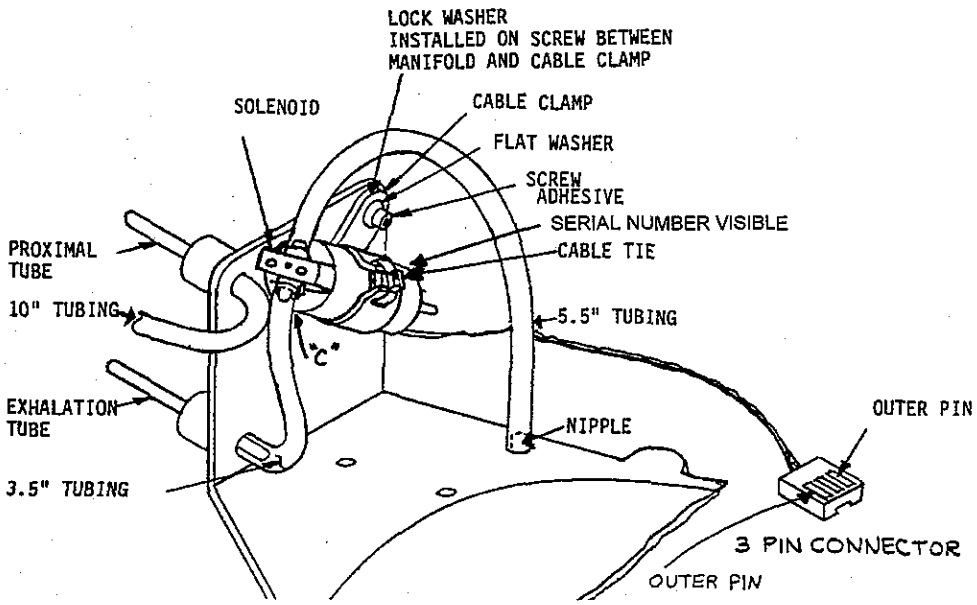


Figure 4.23

4. Inspect manifold assembly for proper assembly and verify 10 brass inserts are present. Replace internal tubing as needed (Figure 4.24).
5. If installing a new cylinder, inspect cylinder and clean with isopropyl alcohol, if necessary.
6. Set cylinder on work surface with motor mounting holes down and closest to you. Insert three alignment pins into every other hole in the top of the cylinder as shown in Figure 4.25.
7. Inspect the manifold and cylinder gaskets for tears and cleanliness.
8. Install cylinder gasket over alignment pins and adjust to fit cylinder. Place manifold assembly over cylinder gasket. Note orientation. (Figure 4.24)
9. Install the manifold gasket over the manifold and install two more alignment pins in manifold as shown in Figure 4.25. Place right end plate over manifold gasket.
10. Inspect cylinder gasket for proper alignment inside and outside of cylinder.
11. Start three 6-32 x 1" screws in the three cylinder holes not having alignment pins. Turn screws down with a hex driver just enough to compress gaskets.
12. Remove the three alignment pins from the cylinder and start three more 6-32 x 1" screws. Remove the remaining alignment pins and start 10 6-32 x 3/8" screws in the remaining right end plate holes.

Figure 4.24



13. Verify the following: manifold gasket is visible around all edges of the manifold and cylinder gasket is visible around the entire interior and exterior of the cylinder.

14. Tighten screws evenly and in a crossing pattern, starting with the cylinder screws, as shown in Figure 4.26.

Figure 4.25

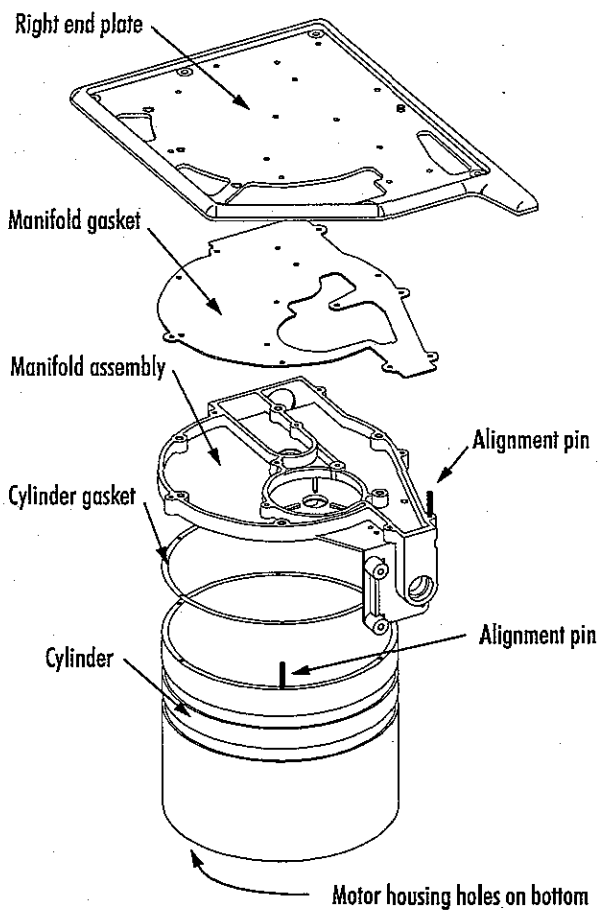
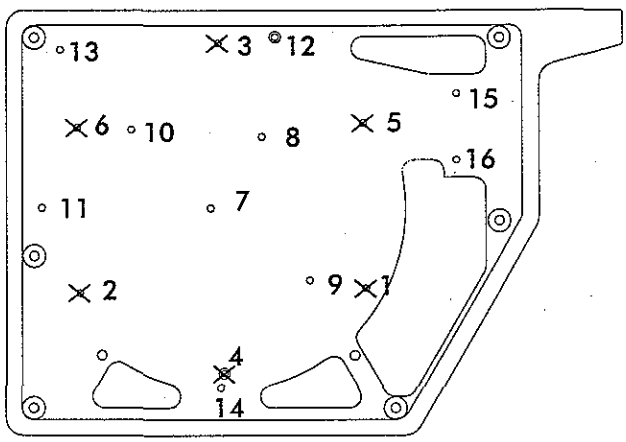
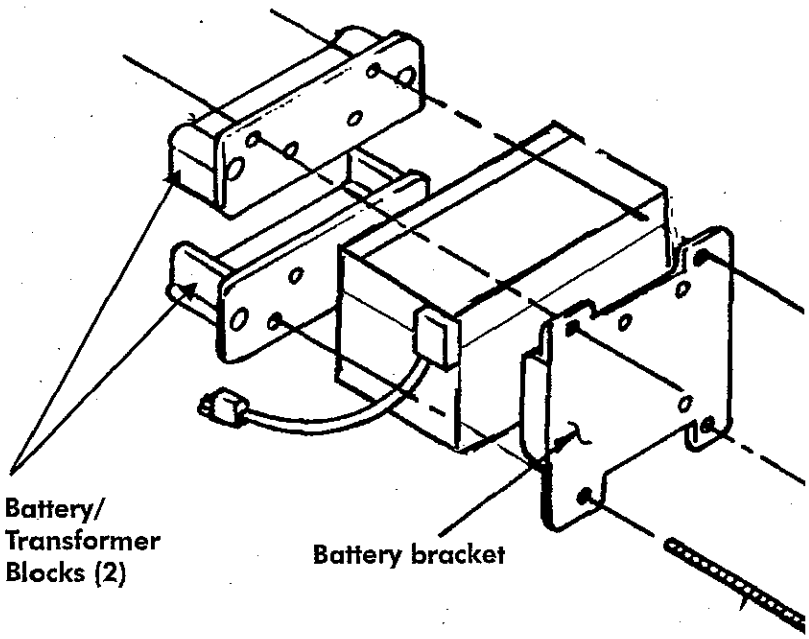


Figure 4.26



Back Panel

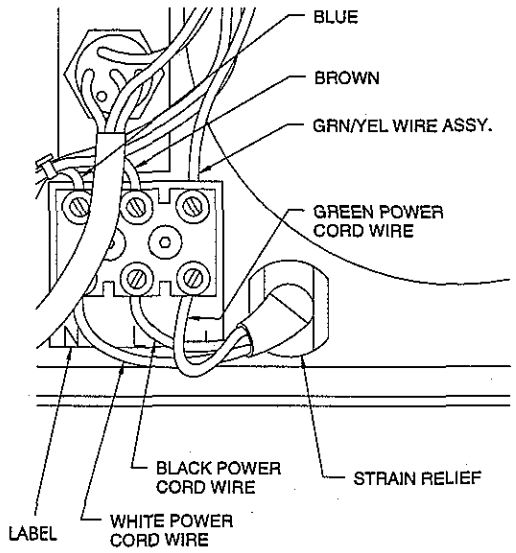
Figure 4.27



Battery Replacement See Figure 4.27.

1. *Verify the two pin connector on the battery assembly is disconnected.*
2. Loosen the four 3" hex screws in the bracket holding the battery assembly in place. Remove the battery.
3. *Check the new battery subassembly for the following:*
   - The black wire is negative and connected to the non-pointed side of the connector.
   - There are no cracks on the battery case.
4. Install new battery and tighten the four 3" hex screws in the bracket holding the battery. Be careful not to overtighten and crack the bracket.

Figure 4.28

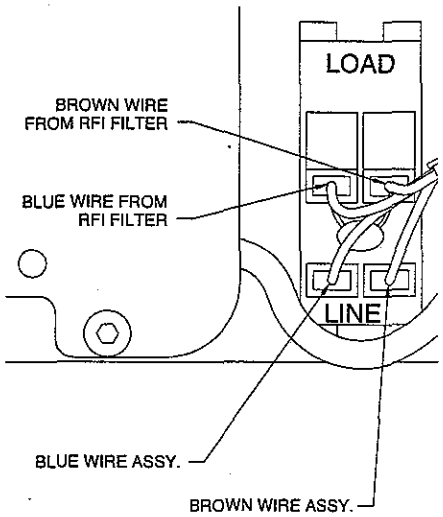


AC Cord Replacement

See Figure 4.28.

1. Note the position of the power cord connections to the terminal strip. Disconnect the power cord from the terminal strip.
2. Squeeze the strain relief with pliers to pull the power cord from the rear panel.
3. Inspect new power cord for properly stripped wires (approximately 5/16") and no insulation damage.
4. Install strain relief on power cord approximately one inch from the end of the large insulation. Orient the strain tab down and the green wire up.
5. Install power cord and strain relief into the back panel.
6. Remove the terminal strip from the back panel.
7. Connect power cord to the terminal strip as shown (Figure 4.28).
8. Apply Loctite 242 to terminal strip screws and reinstall onto the back panel.

Figure 4.29



Replacement of AC ON/OFF Switch

See Figure 4.29.

1. Disconnect the four wires on the old ON/OFF switch, taking note of their location.

2. Depress the two locking tabs on each end of the ON/OFF switch and remove the switch from the back panel.

3. Bend two lugs on the new ON/OFF switch to match the bent lugs on the old ON/OFF switch.

4. Install the new ON/OFF switch in the back panel with the zero toward the bottom edge of the back panel.

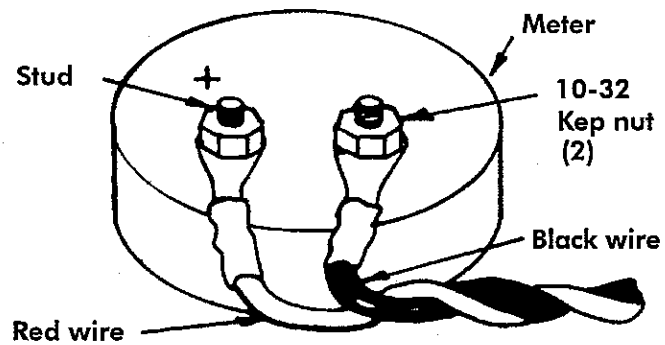
5. Reconnect the four wires to their previous locations on the new ON/OFF switch. The wires from the terminal strip go to the lugs closest to the bottom edge of the back panel (Figure 4.29).

Front Panel

Meter Replacement

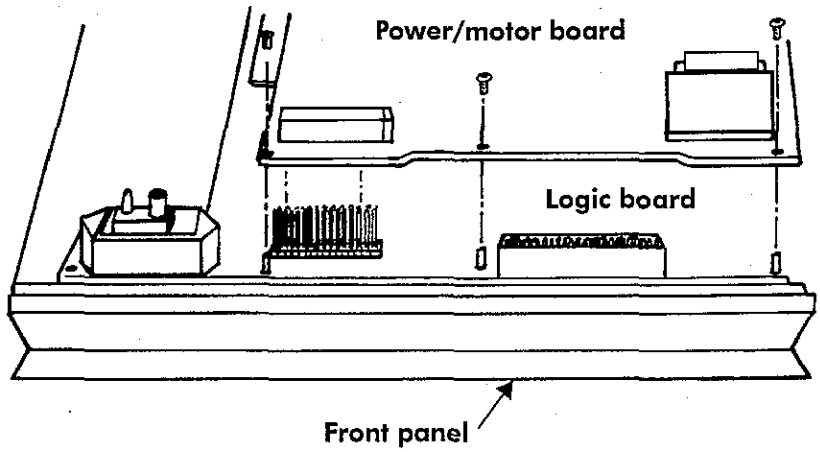
1. Disconnect meter wires from J12 on the Logic Board and remove the two #10 Kep nuts from the meter and remove the wires.
2. Remove and discard the old meter.
3. While holding the replacement meter vertically, verify that the needle can be adjusted at least two divisions each side of -10. Since there are no markings to the left of -10, use your own judgment. Set the needle exactly on -10 when done. Install short piece of foam directly below meter window. Install long piece of foam around the sides and top of meter window.
4. Check the meter window for scratches and debris. Spray meter window with anti-static spray and wipe clean. Install meter into front panel.
5. Install one flat washer on each of the four threaded studs on the meter. Install meter bracket over the round portion of the meter. Install one flat washer, one lock washer, and one brass nut (finger tight) on each stud. Mount meter to the front panel with three screws. Verify meter is straight by looking through meter window of the top overlay. Tighten the brass nuts with a nut driver.
6. Check meter wire assembly for proper crimps, no exposed wire, and no damaged insulation.

Figure 4.30



7. Attach meter wire assembly with the red wire over the stud marked with a plus (+) and the black wire to the other stud as shown (Figure 4.30). To secure wires, place a #10 Kep nut on each stud and hand tighten with 3/8" nut driver.
8. Plug connector to J12 on the Logic Board and tuck wires between circuit boards.

Figure 4.31



Circuit Board Removal

Caution

Use of an anti-static workstation is necessary to handle the front panel and circuit boards safely.

Power/Motor Board Removal

1. Check for the presence of the resistor plug in J3 on the Power/Motor Board; install resistor plug for a minimum of one minute. Remove the five 6-32 x 3/16" button-head hex screws securing the Power/Motor Board to the stand-offs. (Figure 4.31)

2. Remove the 6 - 32 x 3/4" button-head hex screw from the heat sink dampener.

3. Raise the Power Motor Board carefully from the front panel. There are two sets of pin connectors.

Logic Board Removal

Note: Do not remove the pressure limit knob (LP10 only).

1. Turn all seven knobs completely counter-clockwise. Loosen the set screws securing the knobs to the shafts. Remove the knobs and the O-rings (behind BREATHING EFFORT and VOLUME).

2. Remove the five 6-32 x 5/8" stand-offs, the one 6-32 x 3/16" button-head hex screw and the one 4-40 x 3/16" button-head hex screw securing the Logic Board to the front panel.

3. Disconnect the meter wire assembly from J12 on the Logic Board. Disconnect the Display Board ribbon cable from J9 on the Logic Board. (Raise the Logic Board from the front panel.)

Display Board Removal

1. Remove the two 6-32 x 3/16" button-head hex screws from the top of the display board, and the three flat head screws from the bottom of the Display Board. Remove the Display Board.

Circuit Board Replacement
Display Board Installation

1. Check the Display Board for damaged components and traces.

2. *Check the ribbon cable on the replacement Display Board ensuring* that the:

   - Connectors are fully pressed together.
   - Wires are not broken.
   - Colored line on the cable is connected to the #1 pin in the gray connector. (This is the pin indicated by a polarizing mark on the connector.)

3. Mount the Display Board by installing the two 6-32 x 3/16" button-head hex screws on the top of the Display Board. Install the three flat head screws on the bottom of the Display Board using Loctite 242.

Note: The Logic Board and the Power/Motor Board are sensitive to static electricity. Take precautions to eliminate static before handling the circuit boards.

Logic Board Installation

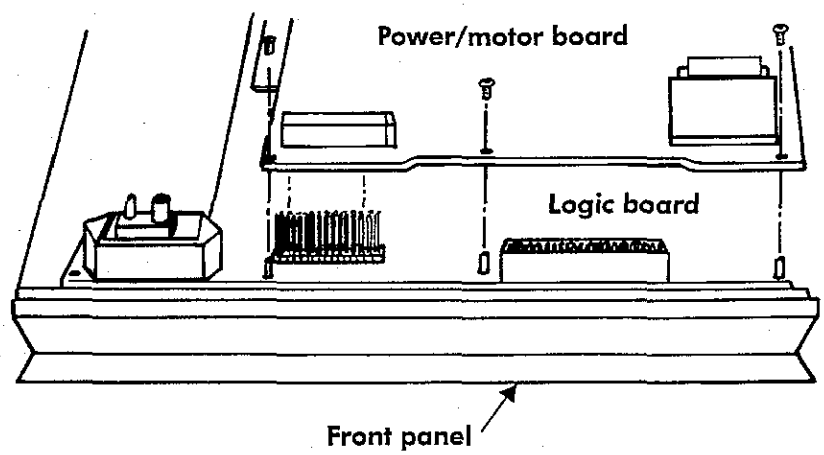
1. Check the Logic Board for the following:

   - The proper orientation of the transducer mounting screws. (The locking nuts should be on the transducer side.)
   - No component damage.
   - No trace or pad damage.
   - Nuts on switches and pots are tight.
   - Polarity of ROMs by matching the notches on ROMs to the notch indicators on the board.
   - All leads are seated correctly and not bent.
   - Presence of "stick-on" labels on the two large EPROM chips (U25 and U26).

2. Mount the Logic Board with five 6-32 x 5/8" stand-offs. Hand-tighten stand-offs using a nut driver. Install one 4-40 x 3/16" button-head hex screw and one 6-32 x 3/16" button-head hex screw.

3. Connect Display Board ribbon cable to J9 on the Logic Board. Connect meter wiring assembly to J12 on the Logic Board.

Figure 4.32



Power/Motor Board Installation

1. Check the Power/Motor Board to ensure that:

   - No component damage exists.
   - The resistor plug is inserted into the J3 connector (at the corner of the board away from the heat sink).
   - Polarity of EPROM (U10) is correct by matching the notches on the ROM to the notch indicator on the board.
   - EPROM leads are seated correctly and not bent.
   - EPROM has a label.

2. Carefully mount the Power/Motor Board by positioning it over the pins in the Logic Board. Press the Power/Motor Board evenly down onto the pins. (Figure 4.32)

3. Check all the pins connecting the boards to make sure that no pins are bent and all pins are fully seated into the connectors.

4. Secure the Power/Motor Board using five 6-32 x 3/16" button-head hex screws.

5. Install a 6-32 x 3/4" button-head hex screw to secure the heat sink dampener to the front panel.

Knob Installation

1. Verify all shafts on the front panel are fully counter-clockwise.

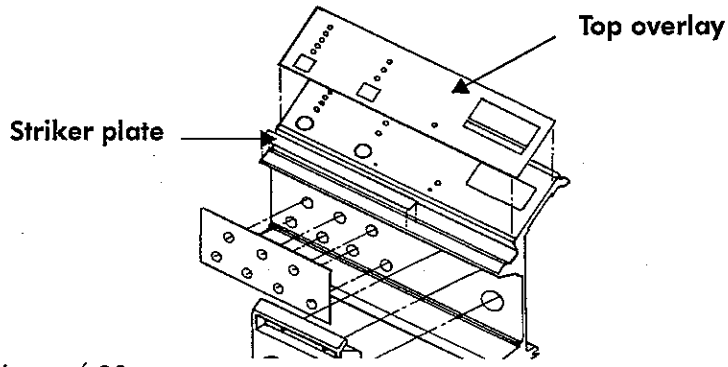
2. Place O-rings into locking knobs and install onto the two shafts with brass nuts (**VOLUME** and **BREATHING EFFORT**). Position the knobs with respect to the minimum overlay markings. Obtain correct spacing with a .025 feeler gauge between the knob and the front panel. Tighten the set screws in each knob.

3. Take five 5/8" regular knobs. Obtain correct spacing with a .025 feeler gauge and orient indicator lines at the minimum (furthest counter-clockwise) setting marks on the overlay. Tighten knobs.

Note: The indicators on the knobs must align precisely with the minimum setting marks on the overlay.

4. Check that all knobs are in fact turned fully counter-clockwise. Check that there is some tension on the locking knobs during rotation.

Figure 4.33



Overlay Replacement

See Figure 4.33.

1. Remove the overlay to be replaced. Scrape the adhesive residue completely from the front panel. Residue left on the front panel where the overlay is adhered will cause a bubble or bump.

2. Check overlays for flaws (scratches, discoloration, bubbles, illegible silk-screening or holes) before installing.

3. Remove adhesive backing from top overlay window, if present. Spray both front and back of meter window area of the top overlay with anti-static spray and wipe to prevent spotting.

4. Check for continuous adhesive on the back of the overlay.

The following are suggestions for installing the overlays:

   a. Peel back a small portion of the overlay backing on one end. Position the overlay accurately and then press down the exposed adhesive portion of the overlay. Now peel the remainder of the backing while pressing down the overlay as the backing is removed to avoid air bubbles from being trapped.

   b. Peel back the entire overlay, carefully holding the edges. Lay overlay on panel lightly and press up the center of the overlay. Smooth overlay from center to outside edges.

5. Check all overlays to ensure edges are even with panel edges. Smooth the overlays as needed.

PLC Replacement (LP10/LP20 only)

PLC Removal

1. Remove the PLC knob and knob spring, using a 1/16" hex driver.
2. Remove the bezel overlay with "Patient Pressure" and "Exhalation Valve" printed on it.
3. Remove the two Phillips head screws from the bezel.
4. Remove the two hex head screws from the bezel, using a 7/64" hex driver.
5. Remove the bezel.
6. Remove the gasket from around the patient pressure port.
7. Remove the four hex head screws from the PLC manifold, using a 5/64" hex driver.
8. Remove the PLC Manifold.

PLC Installation

1. Fasten the PLC manifold to the ventilator's front panel with the four hex head screws, and tighten using a crisscross pattern.
2. Rotate the PLC knob shaft clockwise until the two set screws are pointing to the right of the assembly.
3. Install the patient pressure port gasket.
4. Set the bezel onto the PLC manifold.
5. Install two Phillips head screws in the top of the bezel. Hand tighten, using only light pressure. Do not over tighten.
6. Install two hex head screws in the bottom of the bezel. Hand tighten, using only light pressure. Do not over tighten.
7. Install a new bezel overlay over the two Phillips head screws.

PLC Knob Installation:

1. Install the coil spring over the adjustment shaft to rest around the shaft busing.
2. Install knob base, grooved side connecting with the spring.
3. Align notches in knob base to the corners of the shaft busing.
4. Apply adhesive, LOCTITE 425, to the top knob set screw threads.
5. Compress the spring with the knob base and hold down.
6. Install the top knob on the adjustment shaft, with the set screw on the flat side of the shaft. Tighten the set screw.
7. Check the function of the locking knob.

Forms

On the following pages are blank copies of the forms used when servicing the LP6 Plus, LP10, and LP20 Volume Ventilators. These forms are the:

- Ventilator Run-In Log
- Ventilator Service Record

Photocopy these forms and use them to document maintenance and repair of your ventilator. Use these forms for your internal documentation and to ensure accurate records are kept about necessary maintenance and repairs.

You *must* complete a Service Record and Run-In Log and return a copy to Nellcor Puritan Bennett each time you repair an LP6 Plus, LP10, or LP20 Volume Ventilator.

Ventilator Service Record

NELLCOR PURITAN BENNETT™

Dealer:

Address:

Serial Number: _____

Model: _____

Start Date: _____

Reason for return: _____

Inspection results: _____ Technician: _____ Hours in: _____

LEDSs/Alarms Pass/Fail Software level

Part/Procedure	Serial number	Tech	Date	Work performed	Tech	Date
				Check-In		
				Calibration		
				Reassembly		
				Calibration		
				Reassembly		
				Begin Run-In		
				End Run-In		
				Begin Run-In		
				End Run-In		
				Final		
				Final		

FINAL INSPECTION	P=pass F=fail	FINAL INSPECTION	P=pass F=fail
Visual		Visual	
Controls		Controls	
Alarm check/output test		Alarm check/output test	
Volume Stability (<4)		Volume Stability (<4)	
Relief Valve		Relief Valve	
Power Switch		Power Switch	
High alarm (<35)		High alarm (<35)	
Assembly		Assembly	

Date: _____ Signature: _____ Hours out: _____

NELLCOR PURITAN BENNETT™

Ventilator Run-In Log

Serial Number:_____

DATE	TIME	OCCURANCE
		Begin 1 day run-in.
		Begin battery run-down_____ minutes to low power.
		End battery run-down. Begin 16 hour run.
		End 1 day run-in.

1-day run complete Name

		Begin 1 day run-in.
		Begin battery run-down_____ minutes to low power.
		End battery run-down. Begin 16 hour run.
		End 1 day run-in.

1-day run complete Name

		Begin 1 day run-in.
		Begin battery run-down_____ minutes to low power.
		End battery run-down. Begin 16 hour run.
		End 1 day run-in.

1-day run complete Name

Notes:

PURITAN BENNETT.

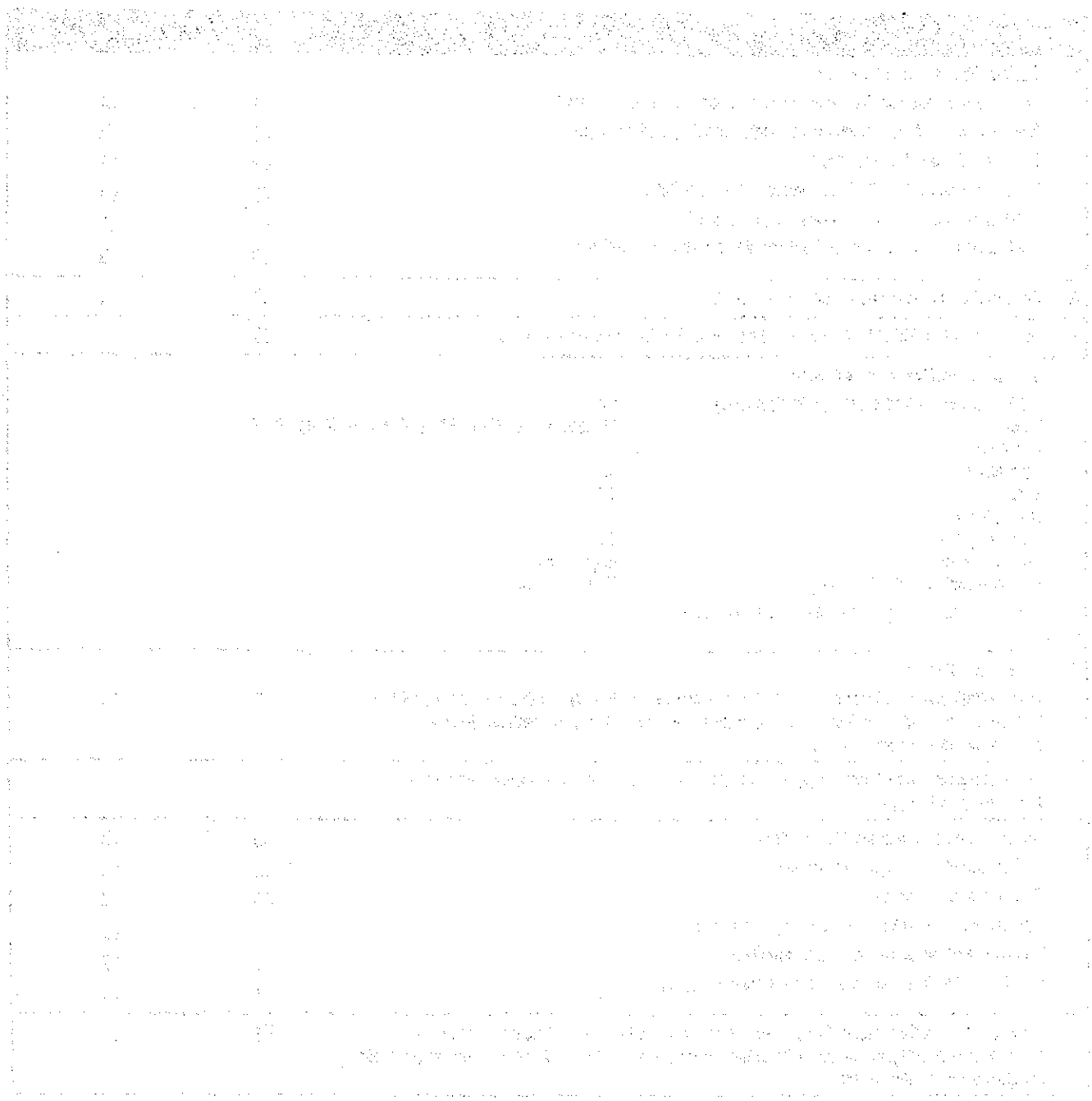
Initial Check-Out and Performance Inspection

Ventilator Model:_____ Ventilator Serial Number: _____

Nellcor Puritan Bennett, Inc., has conducted several quality tests on this ventilator before shipment.

The purpose of this procedure is to provide instructions for the completion of an initial inspection upon receipt. This procedure may also be used for a brief inspection of a ventilator which has not had any internal repairs performed to ensure that it is operating properly.

Procedure		Pass	Fail
1. General Exterior Appearance:			
Any broken or loose knobs, switches, rubber feet, filter housings, etc.?		☐	☐
Any dents or scratches which may indicate dropping or other abuse?		☐	☐
Condition of the AC power cord?		☐	☐
Ensure that no liquid spills have leaked into the ventilator.		☐	☐
Is the exterior surface free of any foreign material?		☐	☐
Is all setting information on the front panel behind the door legible?		☐	☐
2. Ensure that a new air inlet filter is installed.		☐	☐
3. Ensure that the PATIENT PRESSURE needle is within one division of -10.		☐	☐
4. Set the control knobs as follows:			
AC Power Switch (LP20, LP10, LP6 Plus only)	On		
Mode	Standby (LP20/LP10/LP6 Plus) Battery Charge (LP6)		
Low Alarm	2		
High Alarm	90		
Volume	1.0		
Breath Rate	8		
Inspiratory Time	3.0		
Breathing Effort	-5 (approx.)		
Pressure Limit (LP20, LP10 only)	Fully clockwise		
Note: These are test settings and not typical patient settings.			
5. Functional Testing:			
Plug the unit into an AC power source. Turn the **BREATHING EFFORT** knob toward zero until the **BREATHING EFFORT** lamp just comes on. It should light close to the "0" marking. Set the **BREATHING EFFORT** knob back to -5.		☐	☐
Connect a patient circuit and test lung to the **PATIENT AIR** tube, **PATIENT PRESSURE** port, and **EXHALATION VALVE** port.			
Set the **MODE** switch to **ASSIST/CONTROL**		☐	☐
All front panel lamps light momentarily		☐	☐
An alarm sounds momentarily		☐	☐
Only the **AC PWR/BATT. CHARGE** lamp remains lit		☐	☐
The ventilator cycles with no alarm conditions		☐	☐
PATIENT PRESSURE registers with each machine cycle		☐	☐
Disconnect the patient circuit. Attach a respirometer to the **PATIENT AIR** tube and block the **EXHALATION VALVE** port. Measure the volume delivered at the **PATIENT AIR** tube; the respirometer should indicate 1000±100 ml.		☐	☐



Procedure	Pass	Fail
Connect the patient circuit and test lung to the **PATIENT AIR** tube, **PATIENT PRESSURE** port, and **EXHALATION VALVE** port. Set the **HIGH ALARM/LIMIT** to 60 and compress the test lung in your hand. When the pressure exceeds 60, a high pressure alarm should sound and the mushroom valve in the exhalation manifold on the patient circuit should open. Reset the alarm by returning the **HIGH ALARM LIMIT** to 90 and pressing the **ALARM SILENCE/RESET** switch.	❑	❑
Disconnect the test lung from the patient circuit. After two cycles, the **LOW PRESSURE/APNEA** alarm should sound (duel-tone on the LP6, double-pulsed on the LP20). Reconnect the test lung. Reset the alarm by pressing the **ALARM SILENCE/RESET** switch.	❑	❑
LP20 only: Press the **ALARM SILENCE/RESET** button. The **SETTING ERROR/PRESILENCE** LED will light. Press the **ALARM SILENCE/RESET** button again. The **SETTING ERROR/PRESILENCE** LED will turn off.	❑	❑
Plug an external battery into the back of the ventilator. Unplug the AC power cord		
The **POWER SWITCHOVER** lamp blinks	❑	❑
An alarm sounds	❑	❑
The **EXTERNAL BATTERY** lamp lights	❑	❑
The patient pressure continues to cycle with each machine cycle	❑	❑
Press the **ALARM SILENCE/RESET** button to reset the alarm		
Press and hold the **BATTERY TEST** button		
The **EXTERNAL BATTERY** lamp blinks	❑	❑
The battery condition on the **PATIENT PRESSURE** meter indicates:		
LOW❑ MEDIUM❑ HIGH❑ (low battery charge is not acceptable)	❑	❑
Unplug the external battery		
The **POWER SWITCHOVER** lamp blinks	❑	❑
An alarm sounds	❑	❑
The **INTERNAL BATTERY** lamp lights	❑	❑
The patient pressure continues to cycle with each machine cycle	❑	❑
Press the **ALARM SILENCE/RESET** button to reset the alarm		
Press and hold the **BATTERY TEST** button		
The **INTERNAL BATTERY** lamp continues to blink	❑	❑
The battery condition on the **PATIENT PRESSURE** meter indicates:		
LOW❑ MEDIUM❑ HIGH❑ (low battery charge is not acceptable)	❑	❑
Plug the AC power cord back into an AC power source		
To check the number of hours on the ventilator, press the **ALARM SILENCE/RESET** and **BATTERY TEST** buttons at the same time. The value pointed to by the needle on the **PATIENT PRESSURE** meter multiplied by 200 (100 for the LP6) will correspond to the number of operating hours. (e.g., for LP20, LP10, or LP6 Plus, 10 = 2000 hours, for LP6 10 = 1000 hours). Note: hours will not register if less than 250 *(LP6 only)* or less than 350 *(LP6 Plus, LP10, LP20)*.		
The number of hours currently on the ventilator:		
Set the **MODE** switch to **STANDBY** (OFF on the LP6)		
*Set the **AC POWER** switch to OFF (LP20, LP10, and LP6 Plus only)*		

Note any comments on inspection unit, corrective action taken, or recommendations for further action.

_____

_____

_____

Date of test: _____ Inspection performed by: _____

Equipment Calibration

Calibration of Model 6960 Calibrator

Note: Perform this procedure at least every three months.

1. Remove the left side cover from a functional LP6 Plus, LP10, or LP20 ventilator that is ready for calibration. Disconnect the internal battery from the harness.

2. Connect the Calibrator to the Internal Battery harness and the **COMMUNICATION PORT** of the ventilator.

3. Plug the ventilator into AC power and set the **MODE** switch to Standby. Set the back panel ON/OFF switch to ON.

4. Monitor the DC voltage across the red and black wires of the two-pin connector on the Calibrator.

5. Remove the bottom cover of the ventilator. Using a non-conductive screwdriver, adjust R60 on the Power/Motor board such that the monitored voltage is 13.80±0.01 VDC.

6. Adjust the CHARGE VOLTAGE pot on the bottom of the Calibrator until the VOLTAGE LED lights solidly.

Note: Do not press the CHARGE button for longer than 10 seconds at a time. If readjustment is necessary, wait three minutes and then repeat the step.

7. Press and hold the CHARGE button; adjust the CHARGE CURRENT pot on the Calibrator until the voltmeter shows 10.50±0.01 VDC.

8. Pull the syringe on the Calibrator to the end of its stroke and attach a calibrated pressure meter to the open brass port.

9. Apply pressure with the syringe until the pressure meter indicates $50 \pm 0.1 cmH_2O$.

10. Adjust the PRESSURE pot on the Calibrator until the PRESSURE 50 CM LED lights solidly.

11. The contrast of the display can be set as desired by adjusting the display contrast pot on the Calibrator.

Calibration of Model 6951 Right-end Tester

Note: Perform this procedure at least every six months.

1. Disconnect the tubing from the two pressure gauges. Carefully remove the face plates.
2. Connect a large syringe and a calibrated pressure meter to the gauge on the left.
3. Apply 12±0.2 cmH_2O of pressure as indicated by the calibrated pressure meter.
4. Using the zero screw, adjust the needle of the left pressure gauge so it reads 12.
5. Apply 18±0.2 cmH_2O pressure, as indicated by the calibrated pressure meter. The left pressure gauge should indicate 18±2.0 cmH_2O. Repeat this step for pressure readings of 20 cmH_2O and 25 cmH_2O.
6. Connect the syringe and the calibrated pressure meter to the pressure gauge on the right.
7. Apply 100±0.2 cmH_2O pressure, as indicated by the calibrated pressure meter.
8. Using the zero screw, adjust the needle of the gauge so it reads 100.
9. Remove the syringe and pressure meter.
10. Install the face plates and securely reattach the tubing to the gauges.
11. Check the system for leaks and signs of wear.

Technical Bulletins

Keep technical bulletins in this section.

Miscellaneous Information

Keep miscellaneous information in this section.

LP6+/LP10/LP20 SERVICE REPLACEMENT KIT LIST		
KIT NUMBER	**KIT DESCRIPTION**	**CONTENT**
L-1710	Adapter, Test Plug	2 Test Plug Adapters
L-1719	Adhesive, Loctite 242	1 bottle Loctite 242
L-1721	Adhesive, Loctite Primer N	1 bottle Primer N
L-1722	Adhesive,Loctite 642	1 bottle Adhesive Loctite 642
L-1622	Bail Locks, Communication Port	2 Bail Locks
L-1603	Internal Battery	1 Internal Battery
L-1605	Bearing,Crank	1 Crank Bearing
L-1671	Block, Battery	1 Battery Block
L-1606	Bracket, Meter	1 Meter Bracket
L-1672	Bracket, Universal Battery	2 Universal Battery Brackets
L-1690	Breaker DC circuit	1 DC Circuit Breaker
L-1675	Cable, Calibrator	1 Calibrator Cable
L-1688	Cable, Ribbon	1 Ribbon Cable
L-1702	Cap, Filter	5 Filter Caps 5 Labels
L-1602	Carton, Shipping	1 Poly Bag 1 Insert 1 Carton
L-1689	Circuit Board, Display	1 Display Board
L-1686 $ 752.00	Circuit Board, Logic	1 Logic Board
L-1687 752.00	Circuit Board, Power Motor	1 Power Motor Circuit Board
L-1720	Clamp, Solenoid	1 Clamp 1 Lock Washer 1 Flat Washer 1 Screw 1 Cable Tie 1 Piece Tubing
L-1691	Cord,AC	1 AC Cord 1 Warning Label
L-1705	Cover, Bottom LP6+/10	1 Bottom Cover 1 Piece Sound Foam
L-1706	Cover, Left LP6+/10	1 Left Cover 1 Piece Sound Foam 1 Caution Label
L-1707	Cover, Right	1 Right Cover 1 Piece Sound Foam
L-1703 $ 76.00	Cover, Top	1 Top Cover 2 Screws
L-1617	Cover, Port	1 Communication Port Cover

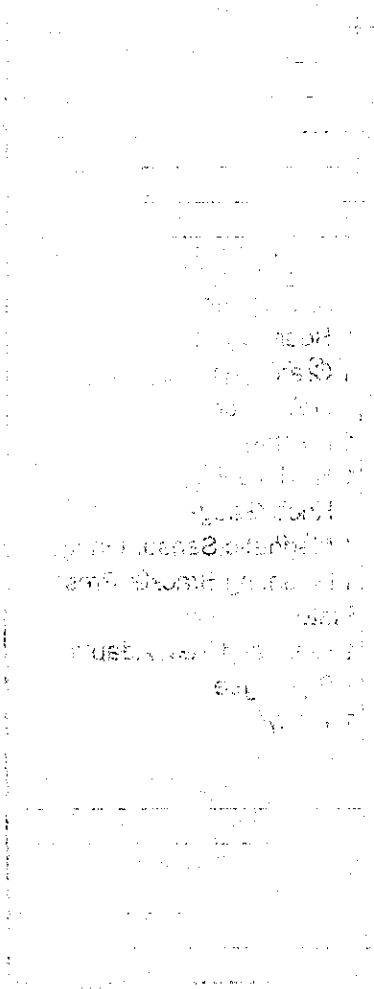
$ 40.00

L-1714	Cylinder	1 Cylinder 1 Cylinder Gasket 2 Danger Decal's
L-1699	Decorative Strip, Front Panel	2 Decorative Strips
KIT NUMBER	**KIT DESCRIPTION**	**CONTENT**
L-1618	Fan for LP6+/10/20	1 Fan $90.00
L-1638	Feet, Bottom for LP6+/10/20	12 Bottom Foot 12 Screws
L-1640	Feet, Cord Wrap for LP6+/10/20	4 Cord Wrap Foot 4 Screw
L-1666	Gasket, Cylinder & Manifold	5 Manifold Gaskets 5 Cylinder Gaskets
L-1680	Guide, Plastic Piston	4 Plastic Piston Guides
L-1695	Handle, Molded	1 Molded Handle
L-1621	Kapseal/Quadring	2 Kapseal 2 Quadring 8 Plastic Piston Guides 16 Screws
L-1696	Knob, Front Panel	5 Knobs
L-1718	Knob,Locking	2 Locking Knobs
L-1715	Knob, PLC for LP10/20	1 PLC Knob
L-1670	Leaf, Manifold for LP6+/10	2 Clear Leafs (Dime Size)
L-1725	Leaf, Manifold for LP6+/10	2 White Leafs (Dime Size)
L-1724	Leaf, Manifold for LP6+/10	2 Leafs (Half Dollar size)
L-1624	Magnetic Strip, Control Door	10 Magnetic Strips
L-1 708	Manifold Assembly	1 Manifold Assembly 1 Manifold Gasket 1 Cylinder Gasket
L-1727	Manifold Assembly	1 Manifold 1 HPR Housing 1 Air Tube 1 Nipple 1 O-Ring 1 Internal Filter 1 Retainer 3 Valve Body 3 Leaf 1 O Ring 1 Gasket Manifold 1 Gasket Cylinder 11/8"x1/4"x5.5" Tubing 11/8"x1/4"x3.5" Tubing 11/8"x1/4"x10" Tubing
L-1682	Meter	1 Meter 1 Long Gasket 1 Short Gasket

L-1628	Motor/Gearbox	1 Motor/Gearbox
L-1628R	Motor/Gearbox Refurbished	1 Refurbished Motor Gearbox
KIT NUMBER	**KIT DESCRIPTION**	**CONTENT**
L-1711	Door, Control for LP6+	1 Control Door 1 Door Overlay 1 Magnetic Strip
L-1612	Mount Connecting Rod	1 Connecting Rod Mount
L-1645	O RIng, Filter Support for LP6+/10/20	10 O-Rings
L-1701	Overlay,Top for LP6+/10	5 Top Overlays
L-1694	Panel,Unassembled for LP6+/10	1 Front Panel 1 Top Overlay 1 Bottom Left Overlay 1 DecorativeStrip 1 Bezel Overlay 3 Gaskets
L-1633	Plug, BackPanel Screen	5 Screen Plugs
L-1630	Plug, Front Panel Meter	20 Meter Plugs
L-1647 79.00	Plug, Green Test	2 Green Test Plugs Order Kit 1710 also
L-1646 79.00	Plug, Red Test	2 Test Plugs Order Kit 1710 also
L-1642	Preventative Maintenance Kit	1 PM Kit
L-1641	Rail Side	2 Side Rails 4 Screws
L-1614	Retainer Cord	5 Retainer Cords
L-1631	Retaining Ring,Crank Bearing	10 Retaining Rings
L-1632	Rod, Control Door	10 Door Rods 5 Springs
L-1643	Screen, Filter Support	5 Filter Support Screens
L-1674	Screw Chassis	25 Screws
L-1652	Screw, Piston Guides	48 Screws
L-1685	Screw, Side Rail	25 Screws
L-1678	Screw, Top Cover	25 Screws
L-1679	Sensor, Magnetic	1 Magnetic Sensor
L-1698	Strain Relief AC Cord	10 AC Cord Strain Relief
L-1656	Sound Foam Bottom Cover	5 Pieces Sound Foam
L-1657	Sound Foam Left Cover	5 Pieces Sound Foam
L-1658	Sound Foam Right Cover	5 Pieces Sound Foam
L-1635	Striker Plate, Front Panel	2 Striker Plate 6 Screws
L-1726	Valve, Solenoid	1 Solenoid Valve 1 Cable Tie

1710 - 2 = $15.00

L-005645-000 Alarm old style



L-1626	Wiring, Meter	1 Meter Wiring
	Line Select	
KIT NUMBER	**KIT DESCRIPTION**	**CONTENT**
L-1648	Tools, Replacement Calibration	1Bearing Place Plate 1 Bearing Press Tool 1 Crank Centering Tool 1 Delrin Screwdriver 1 Discharge Plug 1 HPR Tool 1 Knob Gauge 1 Magnetic Sensor Gauge 1 Mounting Bracket Press Plate 1 Right end Test Adapter 1 Squeegee 1 Twirly
L-6004	LP6+/10/20 Service Module	
L-6004-I	International LP6+/10/20 Service Module	
L-6951	LP6+/10/20 Right End Tester	
L-6960	LP6+/10/20 Calibrator	

~~L-6963~~
0217 Remote Alarm module

NELLCOR
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Additional Tools and Supplies Required

Standard Tools

Allen Drivers:	5/64″
	3/32″
	7/64″
	1/8″ T Handle
	9/64″
Allen Wrenches:	0.050″
	1/16″

Acid Brushes
Deburring Tool
Set of Feeler Gauges
Cable Tie Gun
X-Acto Knife with pointed and chisel blades
Mallet
Small Adjustable Angle Mirror

Nut drivers:	1/4″
	3/16″
	5/16″
	3/8″

Pliers
Needle nose Pliers
Small Needle nose Pliers
Heyco #29 Strain Relief Pliers
Arbor Press
Model 6285 Printer
Single Edge Razor Blade
Model 6212 Remote Alarm
Model 6412-25 Remote Alarm Cable
Ruler
Scissors
Large Screwdriver, Flat
Small Screwdriver, Flat
Anti-Static Workstation
Calibrated Digital Voltmeter

Supplies

Alcohol
Acetone
Oil, 3 in 1
Loctite Assure Electrical Retainer
Spray, Anti-Static, Miller-Stephenson EN-Stat MS-266
Loctite, Tak Pak Accelerator
Silicone, G.E. 280
Loctite Prism 410 Adhesive